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Preweaning and postweaning performance of progeny sired by Charolais, Simmental, Limousin, and Chianina bulls mated with exotic first-cross dams

H. T. Fredeen and J. A. Newman
Research Station, Lacombe, Alta.

J. E. Lawson
Research Station, Lethbridge, Alta.

G. W. Rahnefeld
Research Station, Brandon, Man.

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INTRODUCTION

This report presents interim results of comparisons among crossbred calves sired by bulls from four exotic breeds. The calves were produced in Agriculture Canada's ongoing project to evaluate foreign breeds of cattle. The project was begun in 1968 with the breeding of nine types of hybrid females, produced by crossing Angus, Hereford, and Shorthorn cows with Charolais, Limousin, and Simmental bulls. Hybrid females from each breed cross were randomly allocated to two contrasting environments, namely extensive range at Manyberries, Alta., or intensive farm-type management at Brandon, Man., where their reproductive performance was evaluated. A tenth type of hybrid female, a Hereford–Angus (H × A) cross, was included at each location to serve as a control group.

Red Angus and Beefmaster bulls sired the first calves produced by the hybrid females. Details of the experimental design and results of the evaluation of initial reproductive performance are given in Agric. Can. Publ. 1537, issued in 1974.

For subsequent calvings the terminal sires were Charolais, Chianina, Limousin, and Simmental. Six different sires from each breed were used each year. The mating plan was designed to produce calves with a three-way cross, so none of the females were backcrossed.

Calves were born during the 9 weeks between March 20 and May 22 each year. Each calf was weighed, ear-tagged, and tattooed within 18 h of birth. The calves were dehorned with caustic paste or an electric dehorner before they were 8 weeks old, and all males were castrated by knife during early June. In late September, calves were treated for warbles and vaccinated for I.B.R., PI_3, and clostridium (7-way). Weaning took place in October or early November, and weaning weights were adjusted to 200 days.

All calves entered the feedlot within 2 weeks of weaning. Calves produced at Brandon remained there to be fed, but those produced at Manyberries were transferred for feeding to the Research Station at Lacombe as soon as they were weaned. Heifers were fed in one large lot at Lacombe, but the steers at Lacombe and both sexes at Brandon were penned in groups of 30 or less. Only roughage was fed the first few days. Concentrate ration (Table 1) was then gradually introduced to bring calves onto the full, high-concentrate diet within 4 weeks. A 140-day feedlot test was then begun in early December. The weight of each animal at the start of the test was recorded as the average of two weights taken 2 days apart. From this time until their slaughter the animals received 30% silage mixed with 70% of the grain concentrate mixture at Lacombe and 100% grain concentrate, with neither hay nor silage added, at Brandon. Feed was available ad lib in feed bunks, which provided approximately 60 cm of linear feeding space for each animal. No hormone or other growth stimulants were administered.

Feedlot animals were weighed every 28 days until mid-April, five times during the 140 days of the test. Animals were slaughtered soon after the final weighing, at about 20 head a week. An attempt was made to slaughter the animals from every breed cross at a similar average age, but liveweight was also a factor in determining the slaughter date.

This report summarizes the performance from birth to the end of the 140-day feedlot test of calves born to second and higher parity females and sired by each of the four terminal sire breeds. Postweaning data are included for 2299 calves born during the 4 years between 1973 and 1976. Preweaning traits also include data from 1977, which brings the total observations for evaluating calving difficulty and preweaning mortality to 3379 calvings. These calves were sired by 30 bulls from each breed.

Numbers of calves born to dams from each breed cross are summarized by location and sex of calf in Table 2. The Chianina males sired calves by dams from all 10 breed crosses. However, because backcrosses were not made, dams from only 1 of the 10 breed crosses produced calves sired by Charolais, Limousin, and Simmental bulls.

CALVING DIFFICULTY

Calvings were classified as natural (either unobserved or unassisted), as pulled with ease, as difficult, or as surgical (caesarean section or embryotomy). Summaries of the percentage incidence of difficult calvings are given in Table 3 (males) and Table 4 (females). These tables are constructed to provide, for each location, the valid paired comparisons between sire breeds when mated with dams from each breed cross. The number of calvings involved in each of the percentages shown in these tables is given in Table 2.

Sex of the calf was the most important factor affecting calving difficulty. For males (Table 3), the incidence of difficult (including surgical) births was 9.9% at Brandon and 6.6% at Manyberries compared with 2.5% at Brandon and 1.2% at Manyberries for the females (Table 4). The higher incidence of calving difficulty at Brandon may have reflected differences in the opportunity for exercise under semiconfinement there, compared with that afforded by open range at Manyberries. The cows at Brandon, benefiting from better summer grazing and higher levels of winter feeding, weighed about 90 kg more at calving than cows of the same breed cross at Manyberries. Calves born at Brandon, however, weighed only 1.3 kg more than those at Manyberries.

Male calves by Limousin sires experienced less difficulty at birth than those sired by Charolais (2.6% vs. 12.0%), Chianina (3.2% vs. 10.5%), or Simmental (3.0% vs. 7.8%) bulls (Table 3). Results were consistent within each breed cross of dam at each location, with a low probability (less than 5%) that the differences were due to chance. Results were not consistent within the paired dam breed crosses for the Charolais–Chianina or Charolais–Simmental comparisons, and the sire breed differences in average incidence of calving difficulty could have occurred by chance.

Female calves by Chianina sires gave more difficulty at calving than those by Simmental (3.2% vs. 1.6%) or Limousin sires (2.7% vs. 1.0%). Differences between the remaining sire breed comparisons given in the table could have occurred by chance.

PREWEANING MORTALITY

Summaries of the percentage incidences of preweaning mortality are given in Table 5 (males) and Table 6 (females). These tables, also, are constructed to provide valid paired comparisons between the sire breeds. Mortality includes stillbirths, neonatal deaths, and all other preweaning losses.

Mortality was affected by both sex and location. For males, the losses averaged 12.8% at Manyberries and 7.3% at Brandon compared with 7.9% and 6.4% for females. Early-spring storms coupled with scours contributed to the higher death losses at Manyberries.

Limousin-sired male calves had lower mortality than those sired by the Charolais (4.5% vs. 12.6%), Chianina (5.3% vs. 10.1%), and Simmental (5.2% vs. 11.3%) breeds. The probability that these differences were due to chance was less than 5%. Mortality for Charolais-sired calves was higher than that for Simmental-sired calves (15.4% vs. 6.2%). The other differences observed (Table 5) were not significant and therefore may have been due to chance, but in all comparisons mortality was highest for calves sired by Charolais, followed by Chianina, Simmental, and Limousin breeds in that order at the two locations.

For female calves (Table 6), none of the differences in mortality between sire breeds were significant, and all except the Simmental vs. Charolais comparison (5.1% vs. 10.8%) were probably due to chance.

PREWEANING AND POSTWEANING GROWTH

The average birth weights of steer and heifer calves at Brandon were 44.6 and 41.5 kg (Table 7). Birth weights at Manyberries averaged 1.3 kg lower for steer calves and 1.5 kg lower for heifers. Brandon's 200-day adjusted weaning weights for steer and heifer calves were 218.2 and 207.1 kg, or 19.6 and 16.4 kg heavier than steer and heifer calves at Manyberries. The actual weights at the start of the 140-day feedlot test differed less between locations than the adjusted weaning weights. The average daily gains on feed at the two locations differed very little. At the end of the 140-day feedlot test, steer and heifer calves at Brandon weighed 423.2 and 376.7 kg, 15.4 and 3.7 kg heavier than steers and heifers at Manyberries.

Males were heavier than females at all ages. At Brandon the sex differences were 7.5% at birth, 5.4% at weaning, and 12.3% after 140 days on the feedlot test, with more rapid gains (17.5%) during the feedlot period. A smaller sex difference at weaning was recorded for calves at Manyberries but, as at Brandon, the weight difference increased during the postweaning period.

Comparisons between breeds of sire were made after adjustment for differences associated with sex, breed cross of dam, year of birth, and age of dam. The average performance of calves by breed of sire is given in Table 8 for five growth traits. The table also provides the approximate differences required for statistical significance.

Rankings of sire breeds differed little between locations. Generally, Charolais, Chianina, and Simmental progeny exhibited similar growth traits, whereas Limousin progeny grew 5–10% more slowly than the others. The Chianina progeny exhibited the highest birth weights and adjusted weaning weights, although only the Limousin progeny weighed significantly less. In the postweaning period, the Charolais progeny tended to rank first at Brandon, but for the Manyberries cattle fed at Lacombe the differences among the Chianina, Simmental, and Charolais progeny were small and seldom significant.

SUMMARY

Birth data were recorded at two locations for 3379 three-way cross calves sired by 30 bulls from each of the Charolais, Simmental, Limousin, and Chianina breeds. Little calving difficulty was experienced with female calves, which weighed about 7% (3.1 kg) less than males at birth. Among male calves born under intensive management conditions at Brandon, those sired by Charolais gave the most calving difficulty, followed by Chianina-, Simmental-, and Limousin-sired calves in that order. Considerably less calving difficulty was recorded for the herd maintained under range management at Manyberries, but the order of ranking for breed of sire was the same as that found at Brandon.

From 6.4% to 7.9% of the female calves at Manyberries and calves of both sexes at Brandon died before they were weaned, but for male calves at Manyberries the death rate was significantly higher at 12.8%. The order of ranking of breed of sire remained the same for preweaning mortality of male calves as it did for calving difficulty, and several of the differences between breeds of sire were statistically significant. For female calves differences between breeds of sire in preweaning mortality were generally small, and the rankings at the two stations were not consistent.

Limousin progeny were lightest at all ages, averaging 10% less in birth weight, 6% less in weaning weight, and 11% less in average daily gain on the 140-day feedlot test than progeny from the highest-ranking breed of sire. In birth weight, Simmental- and Chianina-sired calves differed slightly but generally nonsignificantly from Charolais-sired calves, and these three progeny groups were almost identical in weight at weaning. During the 140-day postweaning feeding period, Charolais-sired calves at Brandon grew faster and Limousin-sired calves grew slower than progeny from the other breeds of sire. Chianina- and Charolais-sired calves from the herd at Manyberries grew at essentially the same rate, slightly faster than Simmental-sired calves, which in turn grew faster than Limousin-sired calves.

Final progeny comparisons among the 10 breed crosses of dams involved in this project will be summarized in a later report.

Table 1. Percentage composition of feedlot concentrate rations

Lacombe

Ingredients	Percentage of ration
Barley	73.25
Oats	15.0
Protein supplement (35%)	5.0
Dried molasses beet pulp	5.0
Limestone	1.0
Salt	0.42
Calcium phosphorus (27-13)	0.25
Vitamin A (10 000 000 IU/kg)	0.08

Brandon

Ingredients	Percentage of ration
Barley	50.0
Oats	30.0
Dried molasses beet pulp	15.0
Molasses	2.8
Calcium phosphorus (32-18)	0.5
Limestone	0.75
Urea (45% N feed-grade)	0.5
Salt	0.4
Vitamin A (10 000 000 IU/kg)	0.05

Table 2. Number of calvings (1973–1977) by location, breed of sire, breed cross of dam, and sex of calf

	Manyberries											Brandon											
	Breed cross of dam[1]											Breed cross of dam[1]											Overall
Breed of sire	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Total	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Total	total
												Male calves											
Charolais	—[2]	—	—	32	31	32	22	28	35	33	213	—	—	—	34	45	30	22	27	30	20	208	421
Simmental	22	27	23	—	—	—	16	23	28	31	170	31	24	25	—	—	—	29	28	33	33	203	373
Limousin	25	25	19	30	36	21	—	—	—	32	188	24	29	28	41	45	34	—	—	—	33	234	422
Chianina	25	22	24	38	26	31	23	25	29	37	280	24	35	22	31	31	40	17	24	34	30	288	568
												Female calves											
Charolais	—	—	—	26	31	25	17	17	23	20	159	—	—	—	30	20	35	17	20	25	34	181	340
Simmental	32	21	23	—	—	—	23	20	27	27	173	22	30	21	—	—	—	20	24	29	31	177	350
Limousin	30	26	25	31	29	30	—	—	—	26	197	35	30	19	26	28	29	—	—	—	27	194	391
Chianina	24	28	22	28	32	28	15	17	27	19	240	28	24	23	32	40	29	26	23	23	26	274	514

[1] CH, Charolais × Hereford; CA, Charolais × Angus; CN, Charolais × Shorthorn; SH, Simmental × Hereford; SA, Simmental × Angus; SH, Simmental × Shorthorn; LH, Limousin × Hereford; LA, Limousin × Angus; LN, Limousin × Shorthorn.

[2] Not mated.

Table 3. Percentage of difficult calvings (difficult pulls and surgical deliveries) for male calves, tabulated as paired comparisons of sire breeds bred to common groups of breed crosses of dam

Breeds of sire, paired for comparison	Manyberries											Brandon											
	Breed cross of dam[1]											Breed cross of dam[1]											Overall
	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	Av
Charolais vs.	—[2]	—	—	22	13	9	18	11	6	0	11.3	—	—	—	18	16	13	27	0	23	5	14.6	13.0
Chianina	—	—	—	16	8	10	4	8	7	3	8.0	—	—	—	13	10	15	6	8	11	13	10.8	9.4
Charolais vs.	—	—	—	—	—	—	18	11	6	0	8.8	—	—	—	—	—	—	27	0	23	5	13.8	11.4
Simmental	—	—	—	—	—	—	0	4	4	3	2.8	—	—	—	—	—	—	0	11	6	9	6.5	4.6
Charolais vs.	—	—	—	22	13	9	—	—	—	0	11.0	—	—	—	18	16	13	—	—	—	5	13.0	12.0
Limousin	—	—	—	3	0	5	—	—	—	0	2.0	—	—	—	5	2	6	—	—	—	0	3.2	2.6*
Chianina vs.	4	9	17	—	—	—	4	8	7	3	7.4	4	11	14	—	—	—	6	8	11	13	9.6	8.5
Simmental	0	7	0	—	—	—	0	4	4	3	2.6	19	13	12	—	—	—	0	11	6	9	10.0	6.3*
Chianina vs.	4	9	17	16	8	10	—	—	—	3	9.6	4	11	14	13	10	15	—	—	—	13	11.4	10.5
Limousin	4	0	5	3	0	5	—	—	—	0	2.4	8	0	7	5	2	6	—	—	—	0	4.0	3.2*
Simmental vs.	0	7	0	—	—	—	—	—	—	3	2.5	19	13	12	—	—	—	—	—	—	9	13.2	7.8
Limousin	4	0	5	—	—	—	—	—	—	0	2.2	8	0	7	—	—	—	—	—	—	0	3.8	3.0*
Unweighted average											6.6											9.9	

[1] CH, Charolais × Hereford; CA, Charolais × Angus; CN, Charolais × Shorthorn; SH, Simmental × Hereford; SA, Simmental × Angus; SN, Simmental × Shorthorn; LH, Limousin × Hereford; LA, Limousin × Angus; LN, Limousin × Shorthorn.

[2] Not mated.

* Probability less than 5% that the observed differences between the paired sire breed averages is due to chance. The statistical procedure used is based on Wilcoxon's "matched pairs signed test".

Table 4. Percentage of difficult calvings (difficult pulls and surgical deliveries) for female calves, tabulated as paired comparisons of sire breeds bred to common groups of breed crosses of dam

Breeds of sire, paired for comparison	Manyberries											Brandon											
	Breed cross of dam[1]											Breed cross of dam[1]											Overall
	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	Av
Charolais vs.	—[2]	—	—	0	3	4	0	0	0	0	1.0	—	—	—	3	5	0	0	0	0	3	1.6	1.3
Chianina	—	—	—	0	0	0	0	0	11	0	1.6	—	—	—	0	10	7	0	9	4	0	4.3	3.0
Charolais vs.	—	—	—	—	—	—	0	0	0	0	0	—	—	—	—	—	—	0	0	0	3	0.8	0.4
Simmental	—	—	—	—	—	—	0	0	0	0	0	—	—	—	—	—	—	10	0	7	0	4.2	2.1
Charolais vs.	—	—	—	0	3	4	—	—	—	0	1.0	—	—	—	3	5	0	—	—	—	3	2.8	1.9
Limousin	—	—	—	3	0	0	—	—	—	0	0.8	—	—	—	0	0	3	—	—	—	4	1.8	1.3
Chianina vs.	8	0	0	—	—	—	0	0	11	0	2.7	4	5	4	—	—	—	0	9	4	0	3.7	3.2
Simmental	3	0	0	—	—	—	0	0	0	0	0.4	0	3	0	—	—	—	10	0	7	0	2.8	1.6*
Chianina vs.	8	0	0	0	0	0	—	—	—	0	1.1	4	5	4	0	10	7	—	—	—	0	4.3	2.7
Limousin	0	0	4	3	0	0	—	—	—	0	1.0	0	0	0	0	0	3	—	—	—	4	1.0	1.0*
Simmental vs.	3	0	0	—	—	—	—	—	—	0	0.8	0	3	0	—	—	—	—	—	—	0	0.8	0.8
Limousin	0	0	4	—	—	—	—	—	—	0	1.0	0	0	0	—	—	—	—	—	—	4	1.0	1.0
Unweighted average											1.2											2.5	1.8

[1] CH, Charolais × Hereford; CA, Charolais × Angus; CN, Charolais × Shorthorn; SH, Simmental × Hereford; SA, Simmental × Angus; SN, Simmental × Shorthorn; LH, Limousin × Hereford; LA, Limousin × Angus; LN, Limousin × Shorthorn.

[2] Not mated.

* Probability less than 5% that the differences between the paired sire breed averages is due to chance. The statistical procedure used is based on Wilcoxon's "matched pairs signed test".

Table 5. Percentage of preweaning mortality for male calves, tabulated as paired comparisons of sire breeds bred to common groups of breed crosses of dam

Breeds of sire, paired for comparison	Manyberries											Brandon											Overall Av
	Breed cross of dam[1]											Breed cross of dam[1]											
	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	
Charolais vs.	—[2]	—	—	19	13	16	23	29	20	12	18.8	—	—	—	15	13	3	5	4	20	10	10.0	14.4
Chianina	—	—	—	18	15	10	9	20	14	11	13.8	—	—	—	6	13	5	0	17	3	7	7.3	10.6
Charolais vs.	—	—	—	—	—	—	23	29	20	12	21.0	—	—	—	—	—	—	5	4	20	10	9.8	15.4
Simmental	—	—	—	—	—	—	13	4	7	16	10.0	—	—	—	—	—	—	0	4	3	3	2.5	6.2*
Charolais vs.	—	—	—	19	13	16	—	—	—	12	15.0	—	—	—	15	13	3	—	—	—	10	10.2	12.6
Limousin	—	—	—	3	8	19	—	—	—	3	8.2	—	—	—	0	0	3	—	—	—	0	0.8	4.5*
Chianina vs.	4	9	21	—	—	—	9	20	14	11	12.6	4	9	9	—	—	—	0	17	3	7	7.0	9.8
Simmental	9	4	22	—	—	—	13	4	7	16	10.7	16	4	16	—	—	—	0	4	3	3	6.6	8.6
Chianina vs.	4	9	21	18	15	10	—	—	—	11	12.6	4	9	9	6	13	5	—	—	—	7	7.6	10.1
Limousin	0	12	11	3	8	19	—	—	—	3	8.0	8	3	4	0	0	3	—	—	—	0	2.6	5.3*
Simmental vs.	9	4	22	—	—	—	—	—	—	16	12.8	16	4	16	—	—	—	—	—	—	3	9.8	11.3
Limousin	0	12	11	—	—	—	—	—	—	3	6.5	8	3	4	—	—	—	—	—	—	0	3.8	5.2*
Unweighted average											12.8											7.3	

[1] CH, Charolais × Hereford; CA, Charolais × Angus; CN, Charolais × Shorthorn; SH, Simmental × Hereford; SA, Simmental × Angus; SN, Simmental × Shorthorn; LH, Limousin × Hereford; LA, Limousin × Angus; LN, Limousin × Shorthorn.

[2] Not mated.

* Probability less than 5% that the differences between the paired sire breed averages were due to chance. The statistical procedure used is based on Wilcoxon's "matched pairs signed test".

Table 6. Percentage of preweaning mortality for female calves, tabulated as paired comparisons of sire breeds bred to common groups of breed crosses of dam

Breeds of sire, paired for comparison	Manyberries											Brandon											Overall Av
	Breed cross of dam[1]											Breed cross of dam[1]											
	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	CH	CA	CN	SH	SA	SN	LH	LA	LN	HA	Av	
Charolais vs.	—[2]	—	—	0	3	4	18	12	9	15	8.7	—	—	—	3	15	9	6	5	12	9	8.4	8.6
Chianina	—	—	—	11	6	11	7	6	14	11	9.4	—	—	—	3	8	10	0	4	17	12	7.7	8.6
Charolais vs.	—	—	—	—	—	—	18	12	9	15	13.5	—	—	—	—	—	—	6	5	12	9	8.0	10.8*
Simmental	—	—	—	—	—	—	9	5	7	0	5.2	—	—	—	—	—	—	10	4	3	3	5.0	5.1*
Charolais vs.	—	—	—	0	3	4	—	—	—	15	5.5	—	—	—	3	15	9	—	—	—	9	9.0	7.2
Limousin	—	—	—	10	3	13	—	—	—	7	8.2	—	—	—	4	11	0	—	—	—	7	5.5	6.8
Chianina vs.	8	0	5	—	—	—	7	6	14	11	7.3	14	4	0	—	—	—	0	4	17	12	7.3	7.3
Simmental	6	14	4	—	—	—	9	5	7	0	6.4	4	3	4	—	—	—	10	4	3	3	4.4	5.4
Chianina vs.	8	0	5	11	6	11	—	—	—	11	7.4	14	4	0	3	8	10	—	—	—	12	7.3	7.4
Limousin	7	8	12	10	3	13	—	—	—	7	8.6	3	7	5	4	11	0	—	—	—	7	5.3	7.0
Simmental vs.	6	14	4	—	—	—	—	—	—	0	6.0	4	3	4	—	—	—	—	—	—	3	3.5	4.8
Limousin	7	8	12	—	—	—	—	—	—	7	8.5	3	7	5	—	—	—	—	—	—	7	5.5	7.0
Unweighted average											7.9											6.4	

[1] CH, Charolais × Hereford; CA, Charolais × Angus; CN, Charolais × Shorthorn; SH, Simmental × Hereford; SA, Simmental × Angus; SN, Simmental × Shorthorn; LH, Limousin × Hereford; LA, Limousin × Angus; LN, Limousin × Shorthorn.

[2] Not mated.

* Probability less than 5% that the differences between the paired sire breed averages were due to chance. The statistical procedure used is based on Wilcoxon's "matched pairs signed test".

Table 7. Comparison of preweaning and postweaning growth traits (kilograms ± standard error) for male and female calves born at Brandon and Manyberries[1]

Growth traits and location	Steers	Heifers	Av
	kilograms		
Birth weight			
Brandon	44.6 ± 0.22	41.5 ± 0.24	43.0 ± 0.17
Manyberries	43.3 ± 0.22	40.0 ± 0.22	41.7 ± 0.17
200-day adjusted weaning weight			
Brandon	218.2 ± 1.0	207.1 ± 1.0	212.6 ± 0.7
Manyberries	198.6 ± 1.0	190.7 ± 1.0	194.7 ± 0.8
Weight at start of 140-day feedlot test			
Brandon	232.3 ± 1.1	220.6 ± 1.2	226.4 ± 0.9
Manyberries	220.8 ± 1.3	212.6 ± 1.4	216.7 ± 1.0
Av daily gain on 140-day feedlot test			
Brandon	1.36 ± 0.008	1.12 ± 0.008	1.24 ± 0.006
Manyberries	1.34 ± 0.007	1.14 ± 0.007	1.24 ± 0.005
Weight at end of 140-day feedlot test			
Brandon	423.2 ± 1.7	376.7 ± 1.8	400.0 ± 1.3
Manyberries	407.8 ± 1.8	373.0 ± 1.8	390.4 ± 1.4

[1] All differences are statistically significant ($P < 5\%$) except the station differences in average daily gain.

Table 8. Average preweaning and postweaning growth traits (kilograms ± standard error), with the approximate differences between breeds of sire required for statistical significance at $P < 0.05$

Growth trait and location	Breed of sire				Approximate difference between breeds of sire required for statistical significance at $P < 0.05$[1]
	Charolais	Simmental	Chianina	Limousin	
	kilograms				
Birthweight					
Brandon	43.7 ± 0.36	43.2 ± 0.36	44.4 ± 0.28	40.7 ± 0.34	1.0
Manyberries	42.2 ± 0.33	41.6 ± 0.32	43.6 ± 0.26	39.3 ± 0.31	0.9
200-day adjusted weaning weight					
Brandon	215.4 ± 1.5	215.6 ± 1.5	216.3 ± 1.2	203.2 ± 1.4	4.2
Manyberries	195.3 ± 1.6	196.8 ± 1.5	198.5 ± 1.2	188.1 ± 1.5	4.5
Weight on feedlot test					
Brandon	231.3 ± 1.8	227.9 ± 1.8	230.8 ± 1.4	215.8 ± 1.7	5.1
Manyberries	219.4 ± 2.0	220.2 ± 2.0	218.3 ± 1.6	208.9 ± 1.9	5.6
Average daily gain on 140-day feedlot test					
Brandon	1.30 ± 0.012	1.24 ± 0.012	1.26 ± 0.009	1.16 ± 0.011	0.03
Manyberries	1.28 ± 0.010	1.25 ± 0.010	1.29 ± 0.008	1.14 ± 0.010	0.03
Weight at end of 140-day feedlot test					
Brandon	413.5 ± 2.7	402.2 ± 2.6	406.8 ± 2.1	377.7 ± 2.5	7.6
Manyberries	399.3 ± 2.7	395.3 ± 2.6	398.6 ± 2.1	368.6 ± 2.5	7.6

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[1] Calculated as $2\sqrt{2}$ multiplied by the largest standard error.